RESEARCH HIGHLIGHTS

1991 - 1992

U.S. SUGARCANE FIELD LABORATORY

Sugarcane Research Unit

Agricultural Research Service

United States Department of Agriculture

Houma, Louisiana

MISSION AND STAFF

The mission of the Sugarcane Research Unit is to conduct basic and applied research with the objective of increasing sugarcane production efficiency in the lower Mississippi Delta. A major goal of the Unit is to develop improved sugarcane germplasm and cultivars through conventional breeding and molecular approaches that combine high yield of sugarcane per unit area and sugar per ton of cane, as well as have resistance to disease and insect pests, cold tolerance, ratoon longevity, erectness, and suitability to mechanical harvesting. An equally important goal is to develop efficient, integrated sugarcane production systems involving improved weed, disease and insect control methods and cultural practices.

The productivity of the Research Unit is greatly enhanced by the support of the American Sugar Cane League and the cooperation of the Louisiana Agricultural Experiment Station. The research reported here is a progress report of recent research*. The current USDA-ARS professional staff and the authors of this report are as follows:

PROFESSIONAL STAFF

Benjamin L. Legendre
Research Leader/
Research Agronomist

Michael P. Grisham
Research Plant Pathologist

David M. Burner
Research Geneticist

Rex W. Millhollon
Research Agronomist

Edwis O. Dufrene
Agronomist

Edward P. Richard, Jr.
Research Agronomist

Donnie D. Garrison
Agronomist

William H. White
Research Entomologist

* The data and interpretations in this report may be modified by additional experimentation; therefore, the report should not be published in part or whole without prior approval of the Sugarcane Research Unit, USDA-ARS, Houma, Louisiana and the cooperation agencies and organizations concerned.

BREEDING

Basic Crosses. Cultivated sugarcane in Louisiana can be traced to few exotic relatives. Thus, the genetic base may be limited. The basic breeding program, as contrasted with the commercial breeding program discussed later in this report, was established at Houma in 1972 with several objectives: broaden the genetic base of cultivars; improve resistance to diseases - sugarcane mosaic virus, smut, leaf scald, and ratoon stunting disease; improve resistance to the sugarcane stalk borer; improve leaf and stalk cold tolerance; and increase cane yield through better ratooning ability and better adaptation to mechanical harvesting.

The following breeding procedure is used: 1) cross a cultivar with a selected exotic parental clone, 2) select for desirable type in the hybrid population, 3) cross cultivar with selected hybrid, and 4) repeat steps 2 and 3 several times as necessary. Final selection may require 14 years for the identification of hybrid derivatives suitable for cultivar release.

Since 1972, 4,052 crosses were made from an average of 52 parents/year. Production averaged nearly 323 thousand seed/year, and more than 483 thousand seedlings have been planted and studied. We had record seed set in 1992 (629,000 seed on 111 parents) despite considerable damage to the crossing greenhouse by Hurricane Andrew. There have been 103 candidate cultivars selected from basic crosses, two of which were commercially released (TUCCP 77-42 in 1989 and LHo 83-153 in 1991), and two (HoCP 85-845 and LCP 85-384) scheduled for commercial release in 1993. The last three cultivars were derived from the *Saccharum spontaneum* clone US 56-15-8. An additional 369 clones from basic crosses were selected for crossing to cultivars in the breeding program. **(D.M. Burner and B.L. Legendre)**

Summary of basic breeding program at Houma, LA.

Breeding year	Seedlings set to field	Established in 1st line trials	Established in 2nd line trials	Superior clones receiving permanent assignments US	Superior clones receiving permanent assignments CP
1972-76	138,216	5,302	863	118	22
1977-81	105,429	7,452	1,027	133	45
1982-86	126,131	8,137	1,283	108	34
1987	21,116	1,527	106	10	2
1988	22,425	659	78	---[a]	--
1989	21,065	1,876	193	---	--
1990	16,909	912	----	---	--
1991	14,201	----	----	---	--
1992	18,495[b]	----	----	---	--
Total	483,987	25,865	3,550	369	103

[a] Data not yet available.

[b] Estimated.

Flowering cane in can cultures on photoperiod carts.

Early Selection. The early selection phase of the sugarcane breeding program at Houma is divided into four distinct stages: Stage I, Seedling nurseries planted as spaced (16 in) single stools; Stage II, First-line or first-clonal trials (1 row X 6 ft long); Stage III, Second-line or second-clonal trials (1 row X 17 ft long); and, Stage IV, Replicated nurseries (five locations X 2 or 3 replications, (1 row X 17 ft long). Single stools and first-line trials are advanced to the next stage based on freedom of diseases (mosaic and smut), stalk diameter and height, overall vigor, erectness, absence of pith or hole, and refractometer Brix. Single stools are normally selected in the first-ratoon crop while the first-line trials are selected in the plant-cane crop. Second-line trials are selected in both the plant-cane and first-ratoon crops on the basis of the estimated yield of theoretical recoverable sugar per acre (TRS/A). Data taken in these plots include laboratory Brix, sucrose, purity, and mean stalk weight from a 10-stalk sample. TRS/A is calculated from the stalk population per plot and theoretical recoverable sugar per ton of cane (TRS). Permanent CP (Canal Point), Ho (Houma), or US (United States) numbers are assigned to selected clones from the first-ratoon crop of the second-line trials. Replicated nurseries are now planted at five locations [two at the Ardoyne Farm (one on light and one on heavy soils), one at St. Gabriel (LAES), one at Jeanerette (LAES), and one at Bunkie (Newton Farm)]. Selection in replicated nurseries is based primarily on estimated TRS/A and the absence of diseases.

A total of 87,740 sugarcane seedlings (81% from commercial crosses made at Canal Point and 19% from basic and special crosses made at Houma) were planted to the field in 1991. Concurrently, 7,138 and 739 clones were advanced to the first- and second-line trials, respectively; 80 clones received permanent CP numbers and were planted to the replicated nurseries; and, 22 clones received US numbers and were reintroduced to the crossing program at Houma.

These clones had high Brix, superior agronomic traits, and a high degree of resistance to diseases. New germplasm in the basis crossing program has increased the level of resistance to sugarcane mosaic virus. Low yield potential (TRS/A) in plant and/or ratoon crops and sugarcane smut were the main reasons for discarding new cultivars in the replicated trials.

In 1992, 90,334 sugarcane seedlings (86% commercial and 14% basic) were planted to the field. A total of 5,570 clones were established in first-line trials from ratoon seedlings planted in 1991. A total of 912 clones were advanced to second-line trials, 79 clones assigned permanent CP numbers, and 12 clones received permanent US numbers. Clones advanced should have a high degree of water tolerance due to the excessive rainfall in 1991. Low yield potential (TRS/A) in plant and/or ratoon crops, disease incidence, and poor harvestability were the main reasons for discarding new cultivars in the replicated trials. **(B.L. Legendre)**

Secondary Selection. In the sugarcane breeding program at Houma, experimental cultivars from the CP series are planted in three tests the year following assignment of a permanent CP number. Two of these tests are located off-station. Plot size in these off-station tests is one row wide by sixteen feet long and samples are cut by hand from these plots. The third test is planted in what is known as the infield testing stage at Ardoyne Farm. Plots in infield tests are sixteen feet long by three rows wide (eighteen feet). Each test is made up of two or three replications. The infield is the first stage of the breeding program in which plots are mechanically harvested and then weighed with a tractor-mounted hydraulic weighing system. This is also the first stage in which cultivars from the state breeding program (L's, LCP's, and LHo's) are tested with CP cultivars. Some varietal traits studied in the infield are sucrose, stalk number, stalk weight, estimated tonnage, estimated yield of sugar, and harvestability.

For comparison, three commercial cultivars (CP 65-357, CP 70-321, and CP 74-383) are included in each replication. To be considered for further testing, experimental cultivars must equal or exceed the control cultivars in yield of sugar per unit area, possess an acceptable level of disease and insect resistance, show adaptability to mechanical harvesting, and have good milling qualities (low fiber and good juice extraction).

In 1992, 41 cultivars from the 1991 CP series were planted in two off-station tests and one infield test. Also, 20 cultivars from the 1990 CP series were replanted in an infield test along with 17 cultivars from the 1990 L series. These tests will be harvested in 1993, as will the first-ratoon of the 1988 CP and LCP series, 1989 CP and LCP series, and 1990 CP series, and second-ratoon of 1987 CP and LCP series, 1988 CP and LCP series, and 1989 CP series.

Four cultivars from the 1988 CP and L series remain active in the breeding program. All four of these cultivars are equal to or better than the commercial cultivars in yield of sugar per acre. In the 1989 CP and L series, 15 cultivars remain in active testing in the breeding program. CP 89-816, CP 89-846, L 89-113, and L 89-152 have shown consistently good yields in this series. Seventeen cultivars from the 1990 CP series are still being studied in the infield and nursery stages. Of these cultivars, CP 90-951, CP 90-957, and CP 90-963 have shown the best yields of sugar per acre. **(E.O. Dufrene)**

Outfield Selection. Outfield selection is the final stage in evaluating candidate sugarcane cultivars for release to the Louisiana sugarcane industry. Outfield selection is a cooperative effort between USDA-ARS, Louisiana Agricultural Experiment Station, and the American Sugar Cane League. The work is conducted in cooperation with sugarcane growers at 13 representative locations within the sugarcane belt of Louisiana. Candidate cultivars are tested in replicated

experiments [3 replications, with each plot 3 rows (18 ft) wide x 32 ft long] in the plant-cane, first-ratoon, and second-ratoon crops on both light and heavy soil. A minimum of five commercial cultivars are included as controls in each outfield test.

In 1991, CP 84-730 was significantly higher than CP 70-321 in sugar per acre on light and heavy soils but inconsistent stands and harvestability problems caused this cultivar to be discarded. LHo 83-153, a good ratooning cultivar, has high resistance to mosaic and sugarcane borer. LHo 83-153 was released for commercial planting in 1991.

Average yield of sugar per acre in outfield tests in the plant-cane, first-ratoon, and second-ratoon crops on light and heavy soils during 1991.

	Crop year		
Cultivar	Plant-cane	First-ratoon	Second-ratoon
	lbs		
CP 70-321	5392	4974	3900
LHo 83-153	5658	5451	4751
CP 84-730	6575	6028	5033

In 1992, LCP 85-384 was significantly higher than CP 70-321 in sugar per acre in plant-cane, first-ratoon, and second-ratoon on light soils. HoCP 85-845 was significantly higher than CP 70-321 in sugar per acre in plant-cane. Both of the cultivars have shown good field resistance to sugarcane mosaic virus and smut. HoCP 85-845 is resistant to the sugarcane borer. **(D.D. Garrison)**

Average yield of sugar per acre in outfield tests in the plant-cane, first-ratoon, and second-ratoon crops on light and heavy soils during 1992.

	Crop year		
Cultivar	Plant-cane	First-ratoon	Second-ratoon
	lbs		
CP 70-321	6305	5704	5513
LCP 85-384	7471	7043	6907
CP 85-845	6868	6073	6340

Data on Released Cultivars. The Louisiana Agricultural Experiment Station of the Louisiana State University Agricultural Center, the Agricultural Research Service of the United States Department of Agricultural and the American Sugar Cane League of the U.S.A., Inc., working cooperatively to improve sugarcane cultivars, have jointly developed and hereby announce the release of a new cultivar, LHo 83-153, for commercial planting in the fall of 1991. LHo 83-153 is a product of the cross CP 77-405 X CP 74-339. LHo 83-153 is a high yielding, good ratooning cultivar. Data from mechanically harvested outfield trials on both silt loam and clay soils indicate that LHo 83-153 is superior to CP 70-321 in yield of sugar and cane per acre in ratoon crops. LHo 83-153 is intermediate between CP 74-383 and CP 70-321 in sugar per ton and maturity, with fiber content similar to CP 65-357. The cultivar has been assigned a mill factor of 0.992. The cultivar is generally erect but is less suited to mechanical harvesting than CP 65-357.

The cultivar is resistant to the spread of the sugarcane mosaic virus in the field. LHo 83-153 is considered moderately resistant to smut (caused by Ustilago scitaminea Syd.) and appears resistant to rust (caused by Puccinia melanocephala H & P Syd.) under Louisiana field conditions. Ratoon stunting disease caused significant reductions in cane and sugar per acre yields in ratoon of LHo 83-153. This cultivar is resistant to the sugarcane borer [Diatraea saccharalis (F.)]. Preliminary data suggest LHo 83-153 is tolerant of most herbicides used in sugarcane production. **(K.P. Bischoff, S.B. Milligan, F.A. Martin, E.O. Dufrene, J.P. Quebedeaux, K.L. Quebedeaux, J.W. Hoy, T.E. Reagan, M.J. Giamalua, B.L. Legendre, and P.H. Dunckelman)**

Release of Sugarcane Borer Resistant Germplasm. The 1992 growing season was once again a frustrating year for farmers in their efforts to control damaging populations of sugarcane borer with conventional insecticides. Although the amount of insecticide used for controlling the borer in 1992 was about ¼ that used in 1991, several fish-kills were reported and attributed to the insecticide aziphos - methyl. Once again, emergency restrictions were initiated by the Louisiana Department of Agriculture & Forestry to reduce the risk of additional fish-kills. The events of the last two years gives impetus to our search for alternatives to insecticides for controlling sugarcane borer by breeding sugarcane cultivars with increased levels of resistance to sugarcane borer. Plant resistance is a control tactic that offers the possibility of reducing, if not eliminating, the amount of insecticide use.

In 1992, five germplasm clones were released providing plant breeders with material expressing greater resistance to sugarcane borer than is currently found in Louisiana cultivars. These germplasm clones were identified in progeny of biparental crosses made at Canal Point, FL and selected during a five year period at Houma, LA. In addition to borer resistance, they also appeared resistant to the spread of sugarcane mosaic virus and smut in the field, were generally erect, and had acceptable yields and plant type.

The recurrent selection program that produced these five selections continues and further releases are anticipated in the future. **(W.H. White and B.L. Legendre)**

Yield of five sugarcane germplasm clones and two commercial standards.

Clone	Parentage	Stalk no.	Stalk wt.	Crop yield CRS	Cane	Sugar
	Female/ Male	(#/ acre)	lbs	(lbs/ ton)	(ton/ acre)	(lbs/ acre)
US 90-18	CP 79-348[a]/ CP 83-657	54757	2.0	237	44	10362
US 90-21	CP 79-332/ CP 83-657	44298	2.2	229	39	8883
US 90-24	CP 79-332/ CP 83-657	43068	3.2	192	54	10394
US 90-26	CP 79-348[a]/ CP 83-657	44298	2.7	245	46	11375
US 90-27	CP 81-332/ CP 83-632	43068	3.4	226	57	12920
CP 74-383[b]	CP 65-357/ L 65-69	34000	2.8	235	46	10751
CP 70-321[c]	CP 61-39/ CP 57-614	35500	3.2	249	52	12835

[a] Selection from a basic cross of S. robustum.

[b] Susceptible commercial standard.

[c] Resistant commercial standard.

TISSUE CULTURE

Substantial numbers of offtypes are produced through in vitro culture of CP 74-383. This limits in vitro-facilitated clean seed production. In this study, plants produced in vitro by callus culture, direct regeneration, and shoot tip culture were compared in the field with conventional bud propagated plants. As expected, tissue culture plants were inferior to the check in having higher offtype frequency, shorter height, smaller stalk diameter, and lower stalk weight in plant-cane and first-ratoon crops. Morphological traits of 'normal' and offtype plants selected from the tissue culture population appear to remain stable with vegetative reproduction. Subclones selected for high sucrose from this and other tissue culture studies are being evaluated for their agronomic potential. **(D.M. Burner and M.P. Grisham)**

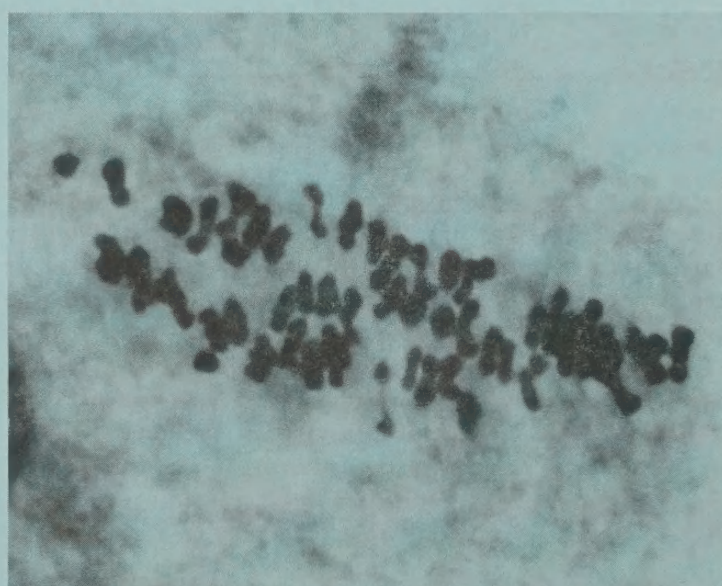
CYTOLOGY

Sugarcane species are polyploids possessing 4 to perhaps 12 or more sets of chromosomes. Chromosome number and chromosome pairing have been analyzed for many elite and exotic clones used in the breeding program. This information is useful in taxonomy, confirming clonal identity, and predicting genetic stability for breeding and molecular biology studies.

Results indicate that normal chromosome pairing predominates in most clones, although many elite breeding clones exhibit aneuploidy (uneven number of chromosomes) and chromosomal mosaicism (chromosomes vary in number among cells within the plant) causing pollen to vary in chromosome number. Elite sugarcane clones and S. officinarum-like hybrids transmit the haploid number of chromosomes in crosses with S. spontaneum, unlike S. officinarum clones which transmit the somatic number of chromosomes in crosses with S. spontaneum. The clone CP 33-224 was found to be desynaptic (chromosomes fail to recombine properly) and may form functional pollen with a doubled chromosome number. Chromosome pairing becomes somewhat less stable with hybridization indicating some degree of genetic recombination. This is necessary for genes from exotic species to be transferred to elite clones. **(D.M. Burner, B.L. Legendre, P.Y.P. Tai, and J.D. Miller)**

Chromosome counts for selected exotic and elite sugarcane clones and related species.

Clone	Chromosome number	Species
SES 372	20	Erianthus elephantinus
US 58-4-2	30	Narenga porphyrocoma
Kalimpong	40	E. procerus
SES 189	50	Saccharum spontaneum
IK 76-99	60	E. arundinaceus
Nepal	72	S. spontaneum
Molokai 5099	80	S. robustum
PIN 84-1	96	S. spontaneum
Green German	108	S. officinarum hybrid
CP 70-321	110	Saccharum spp. cultivar
LCP 82-89	109-116	Saccharum spp. cultivar
Muntok Java	141	S. officinarum hybrid
NG 77-199	166	S. robustum
NG 77-193	192	Miscanthus hybrid



Metaphase I of CP 74-383 with 108 chromosomes.

PLANT PATHOLOGY

Sugarcane Mosaic. Cultivars of sugarcane differ in the amount of yield loss caused by infection with the sugarcane mosaic virus (SCMV). Among the currently recommended cultivars, only two are resistant to the SCMV - CP 76-331 and LHo 83-153; the others vary from susceptible to moderately resistant. Two cultivars scheduled for release in 1993, HoCP 85-845 and LCP 85-384, are resistant to the SCMV.

Fields of CP 65-357 KT which initially had very low levels of mosaic were monitored for establishment and spread of mosaic. The pattern of disease increase differed between the 1990-1991 and 1991-1992 seasons. In the first season, the highest rate of increase occurred in late winter until May. In second season, there was a rapid fall increase and a second period of rapid increase in mosaic in May-June. **(M.P. GRISHAM)**

Sugarcane Smut. Candidate cultivars of sugarcane are screened for resistance to smut (Ustilago scitaminea) by dip inoculating seed cane in a 5 X 10^6 teliospores per ml suspension for 10 minutes prior to planting. The mean percent shoots infected is used to group the candidate cultivars into resistant, intermediate, and susceptible classes. The 1990 series of cultivars had not been previously screened in an inoculated test. The high percentage of cultivars in the resistant and intermediate classes among the 1984-90 series reflects the elimination of highly susceptible cultivars exposed to earlier natural inoculation and better parent selection for resistance to smut. **(B.L. Legendre and M.P. Grisham)**

Number and percent of CP, LCP, and L sugarcane cultivars assigned to three smut resistance classes following the 1992 inoculated trial.

Series of cultivars	Resistance classes					
	Resistant		Intermediate		Susceptible	
	No.	%	No.	%	No.	%
1984-88	24	96	0	0	1	4
1989	42	79	10	19	1	2
1990	39	67	13	22	6	10
Total	105	77	23	17	8	6

Ratoon Stunting Disease. The effect of ratoon stunting disease (RSD), caused by Clavibacter xyli subsp. xyli, was determined for the eight recommended cultivars. Yield of diseased-infected plants was compared to the yield of uninfected plants. Because most yield losses caused by RSD are observed in the ratoon crops, only ratoon results are shown in the table.

Increasing the planting rate from 2 to 4 running stalks led to higher yields of both healthy and RSD-diseased cane in plant-cane, but the advantage of the higher planting rate was lost in first- and second-ratoon crops. **(M.P. GRISHAM)**

Leaf Scald. Leaf scald, caused by Xanthomonas albilineans, was first observed in clonal trials at the Sugarcane Research Unit's farm on 3 November 1992. The disease was subsequently found on three commercial farms. At one farm, the disease was found in cultivar development research plots and, at the other two farms, in commercially grown cane. An extensive survey of other locations will be conducted during 1993 and an evaluation of the susceptibility of Louisiana cultivars and advanced breeding clones will be made. **(M.P. Grisham and B.L. Legendre)**

Percent loss of yield (pounds sugar per acre) in sugarcane caused by ratoon stunting disease (RSD).

Cultivar	Crop years			
	1989-1991		1990-1992	
	First-ratoon	Second-ratoon	First-ratoon	Second-ratoon
	%			
CP 65-357	22**a	15	(1)b	41**
CP 70-321	17*	26*	(1)	2
CP 72-370	35**	44**	38**	81**
CP 74-383	30**	14	--	--
CP 76-331	21**	28**	--	--
CP 79-318	9	17*	3	13
CP 82-89	59**	52**	23	21*
LHo 83-153	40**	24*	33*	56**

[a] Mean of four replicates. * = significant at P = 0.05, and ** = significant at P = 0.01.

[b] ( ) = RSD-infected had higher yield than healthy.

ENTOMOLOGY

Insecticide Screening. Research continues on evaluating new insecticides for controlling damaging infestations of the sugarcane borer. Only two compounds are currently labelled for the control of borers in sugarcane. Both azinphos-methyl and esfenvalerate have serious flaws which limit their use in controlling sugarcane borer. Several fish kills in the cane region in 1991 and 1992 were attributed to azinphos-methyl (trade names Guthion and Sniper), while esfenvalerate (trade name ASANA) has been characterized as less effective than azinphos-methyl for controlling sugarcane borer and is believed to trigger damaging infestations of the yellow sugarcane aphid. Two compounds have shown promise in controlling sugarcane borer and Section 18 exemptions by EPA (The Environmental Protection Agency) have been submitted. These compounds are cyfluthrin (trade name Baythroid) and acephate (trade name Orthene). Baythroid will be recommended as single compound or as a tank mix with azinphos-methyl while Orthene would be used in a tank mix with ASANA. All treatment combinations have been shown to offer effective control of sugarcane borer, would offer the choice in rotating chemistry, and would reduce the chance of enhancing yellow sugarcane aphid populations. This work has been done in cooperation with the Louisiana Cooperative Extension Service and the Entomology Department, Louisiana Agriculture Center. **(W.H. White)**

Adult moth of sugarcane borer
(Diatraea saccharalis)

JUICE, CANE, AND MILLING QUALITY

Juice and Milling Quality. An average of 6,508 samples were processed and analyzed in the Juice and Milling Quality Laboratory at the Ardoyne Farm, Houma, LA during the 1991-1992 harvest seasons. User scientist included: American Sugarcane League of the U.S.A., Inc. (ASCL), Thibodaux, LA; Louisiana Agricultural Experiment Station (LAES), and Louisiana Cooperative Extension Service (LCES), Baton Rouge, LA; Sugar Processing Research Institute, Inc. (SPRI), New Orleans, LA; and United States Department of Agriculture, Agricultural Research Service (USDA-ARS), Houma and Baton Rouge, LA.

The traditional 3-roll mill was used for approximately 68% of the samples in each of the two years. Extracted juice (40-50% by weight of cane) was analyzed for Brix by refractometer and sucrose by polarization using aluminum chlorohydrate. From these data and the use of a Varietal Correction Factor (VCF), the estimated yield of theoretical recoverable sugar per ton of cane (TRS/TC) was calculated for each sample. The VCF takes into consideration the fiber and juice extraction % cane obtained from prior tests for each cultivar as well as considers the potential sugar loss in the final molasses using the Winter-Carp formula. The prebreaker/press method was used for the remaining 32% of the total. Data obtained for each sample included Brix % cane, sucrose % cane, and fiber % cane. From these data, TRS/TC was calculated directly. These results are similar to predicted values for TRS/TC using the core/press method employed at 19 of the State's commercial mills. The prebreaker/press method is particularly useful to those experiments where the cane quality may be affected by factors other than the cultivar, i.e. borers, weeds, diseases, trash, etc.

In the first of two cooperative studies, in 1991, a YSI Analyzer was compared to an automatic saccharimeter in the determination of the sucrose content of 871 sugarcane juice samples. The coefficient of determination (R Squared) for sucrose derived from the two instruments was only 0.81, indicating considerable variability in the sucrose readings. The results indicated that the YSI Analyzer could not be substituted for the saccharimeter in sucrose analysis of sugarcane juice samples because of the loss of precision and reliability.

In the second study, a NIR/Systems Model 6500 scanning near infra-red spectrophotometer (NIR), with appropriate software, was tested for the second year on the analysis of sugarcane juice for Brix and sucrose. Over 300 samples were analyzed against calibration curves developed from the 1990 crop. The correlation coefficients for both Brix and sucrose were 0.99 indicating a near perfect relationship. Further, the data showed that calibration curves developed for one area or laboratory could be used for another area or laboratory. Also, the data indicated that the calibration curves developed one year may be used for the same area the following year. It appears that at this point NIR technology can be substituted for the use of the saccharimeter in analysis of sugarcane juice without the loss of precision and reliability.

In 1992 an NIR/Systems model 6500 scanning near infra-red spectrophotometer (NIR), with appropriate software, was tested for a third year on the analysis of sugarcane juice to further develop calibration curves in cooperation with Sugar Processing Research Institute, Inc. (SPRI). These and other calibrations can be used along with those for pol and Brix to give analysis on unclarified, unfiltered cane juice for pol, Brix, purity, true sucrose (by HPLC), and dextran in a few minutes. This is the first time that an NIR calibration for rapid analysis of dextran in sugarcane juice has been developed.

Also in 1992, two dark solution polarimeters (saccharimeters) using the 880nm wavelength were tested on unclarified, unfiltered cane juice. This wavelength is in the near infrared (NIR) range of the electromagnetic spectrum and was touted to easily penetrate optically clear sugar solutions without the need for costly, time consuming, and sometimes toxic decolorization procedures. However, both instruments were not able to read 'raw' sugarcane juice samples without significant dilution, sample preparation, or decolorization by chemical means or ultrafiltration.
(B.L. Legendre)

Glyphosate-Induced Changes in the Sugarcane Composition. The plant growth regulator glyphosate (N-phosphonomethyl glycine) was labelled for sugarcane in Louisiana and Florida in 1980 as a foliar spray to hasten maturity and extend the period of high sucrose levels of ratoon (regrowth) cane only. However, as early as 1983 there was concern that glyphosate also increased the level of polysaccharide, notably dextran, in juice of harvested cane. In preliminary studies conducted in 1985 and 1986, no association was found between the use of glyphosate for increasing sucrose content and the level of dextran in the juice of treated cane. Further, the data indicated that dextran levels (ppm on solids) of the juice were not influenced by removal of the leaves above the apical meristem of the cane with or without glyphosate. Field studies were repeated in 1992 in ratoon cane of three sugarcane cultivars (CP 65-357, CP 70-321, and CP 72-370) to study the effects of glyphosate and five topping heights (no removal of tops and 5 cm above and 10,

25, and 40 cm below the apical meristem) on the composition of sugarcane juice. Factors studied which could have an effect on processing included sucrose and purity % cane, theoretical recoverable sugar (TRS) per ton of cane, fiber % cane, invert and inorganic ash % juice, total polysaccharide, dextran, starch, and leucoanthocyanin pigments.

The study revealed that glyphosate increased sucrose % cane and TRS per ton of cane regardless of cultivar but had no effect on purity % cane. Both sucrose and purity % cane increased with topping with or without glyphosate. Glyphosate lowered fiber % cane regardless of cultivar while fiber % cane differed among cultivar. However, fiber % cane remained constant once the portion 5 cm above the apical meristem was removed. Glyphosate caused a reduction in invert (glucose and fructose) % juice with time after treatment when compared to the untreated control regardless of cultivar. Glyphosate had apparently no effect on inorganic ash while inorganic ash differed with cultivar and topping height. Glyphosate increased total polysaccharide regardless of cultivar. Glyphosate apparently increased the level of dextran with no changes noted among cultivars or topping heights. Starch was not affected by glyphosate or topping height but did differ among cultivars. Finally, leucoanthocyanin pigments were also increased by glyphosate for the cultivar CP 72-370 but decreased with topping. In these studies, glyphosate increased the yield of recoverable sugar per ton of cane; however, this increase does not come without some negative responses, namely the apparent increase in total polysaccharide and dextran which can ultimately contribute to sugar losses and color formation. **(B.L. Legendre, M.A. Clarke, and M.A. Godshall)**

Glyphosate induced changes in the composition of sugarcane.

	Glyphosate[1]			
	No		Yes	
	Topping[2]		Topping[2]	
Component	No	Yes	No	Yes
Sucrose (%)	15.6	16.3	16.3	17.1
Purity (%)	92.1	93.2	89.1	90.7
Fiber (%)	12.1	11.8	12.6	11.5
TRS (kg)	139	146	143	152
Ash (%)	0.51	0.44	0.56	0.42
Polysaccharide (PPM)[3]	5000	5124	6493	5764
Dextran (PPM)[3]	249	415	526	497
Starch (PPM)[3]	886	1157	1206	1204
Leucoanthocyanins (RA)[4]	81	68	128	121

[1] Polado L applied at 0.3 kg (9.5 oz)/ha.

[2] 25 cm below apical meristem.

[3] PPM on solids.

[4] RA = Relative Absorbance.

Hurricane Andrew Damage Assessment. On August 25 and 26, 1992, Hurricane Andrew, packing sustained winds of 140 MPH with gust exceeding 160 MPH crossed the Louisiana coastline between Terrebonne and St. Mary Parishes. The 'Eye' of the storm passed approximately 30 miles to the west of Houma sparing the immediate area with the most destructive winds; however, it was estimated that winds in excess of 100 MPH pelted the area for more than four hours. Its initial northwesterly and later northerly course brought hurricane force winds over most of the 20 sugarcane growing parishes of the State. The immediate reaction by the press was complete destruction of the entire Louisiana sugarcane crop. An assessment made parish-by-parish predicted the losses ranging from a low of 10 percent in the fringe areas of the hurricane's path to over 50 percent in the area of the eye of the storm. The weighted average loss for the State was set at 25 percent.

During harvest, field surveys were made in St. Mary Parish, the area hardest hit by the storm. Damage assessments in standing cane were made in six commercial cultivars (CP 65-357, CP 70-321, CP 72-370, CP 79-318, LCP 82-89, and LHo 83-153) in both the plant and/or ratoon crops. Losses of tons cane per hectare per 1% broken stalks averaged 0.19% for all cultivars (range, 0.08% for CP 79-318 to 0.31% for CP 65-357). Losses of theoretical recoverable sugar per ton of cane per 1% broken stalks averaged 0.20% for all cultivars (range, 0.16% for both LCP 82-89 and LCP 83-153 to 0.25% for CP 79-318) while the overall loss in theoretical recoverable sugar per hectare per 1% broken stalks averaged 0.35% for all cultivars (range, 0.30% for LCP 82-89 to 0.43% for CP 65-357). The actual percentage of broken stalks in these fields ranged from a low of less than 20% to a high of over 55%.

Hurricane Andrew* Damage Assessment

	Losses / 1% Broken Stalks					
Cultivar	TC/A		TRS/TC		TRS/A	
	(TONS)	(%)	(LB)	(%)	(LB)	(%)
CP 65-357	0.067	0.31	0.532	0.18	27.18	0.43
CP 70-321	0.072	0.24	0.597	0.24	31.63	0.42
CP 72-370	0.050	0.17	0.508	0.19	26.25	0.32
CP 79-318	0.023	0.08	0.703	0.25	25.11	0.31
LCP 82-89	0.048	0.17	0.461	0.16	24.15	0.30
LHo 83-153	0.046	0.18	0.520	0.16	25.36	0.32
Averages	0.053	0.19	0.543	0.20	28.66	0.35

*August 25-26, 1992.

The actual tons processed (8,151,106) during the 1992-93 harvest amounted to a 14.4% loss assuming the pre-hurricane estimate of 9,525,600 tons was correct. Further, there was a corresponding loss of total sugar produced of 17.8% because of the lower than anticipated recovery of sugar per

ton of cane. Hurricane Andrew caused an estimated $78.8 million in direct monetary losses (assuming a price of sugar at $0.46 per kilogram) to the sugarcane growers, processors, and landlords in Louisiana at the first processing level. This does not take into consideration the increase in cost to plant and harvest hurricane damaged sugarcane. **(B.L. Legendre)**

Sugarcane field in St. Mary Parish heavily damaged by Hurricane Andrew.

WEED CONTROL AND CULTURAL PRACTICES[a]

<u>Itchgrass Biology</u>. Itchgrass biotypes from 34 countries were evaluated under controlled and natural daylength. They could be placed in five broad groups based primarily on the effect of daylength on flowering but also on general morphology and pattern of growth. The Group 1 biotypes, which included similar biotypes from Louisiana, Florida, and North Carolina, were not affected by daylengths of 12 and 14 h and flowered 35 to 57 days after germination. The Group 2 biotypes, which were primarily from Africa, flowered 54 to 67 days after germination and were taller with fewer and larger diameter culms than the Group 1 biotypes. The Group 3 biotypes were moderately sensitive to photoperiod and took longer to flower at 14 h than at 12 h. The Group 4 biotypes, which included one biotype from Louisiana, were short-day plants that did not flower in the screenhouse until August or September. The Group 5 biotypes were strict short-day plants that only flowered in September to November after the daylength had decreased to about 12 h. Most biotypes, including all of those from North America, were diploids with 2n = 20 chromosomes, but some, particularly those from Asia, were polyploids with 2n = 40 or 60. **(R.W. Millhollon and D.M. Burner)**

<u>Itchgrass Control</u>. Heavy infestations of itchgrass are controlled effectively when the dinitroaniline herbicides trifluralin and pendimethalin are incorporated into soil. However, soil incorporation is a tedious and inefficient procedure that causes some injury to the cane. Research conducted over several years showed that pendimethalin and prodiamine, another dinitroaniline herbicide, will provide >75% control of itchgrass without being incorporated into soil. Control could be improved to >95% when asulam was applied postemergence to itchgrass seedlings that were not controlled preemergence. Other experimental herbicides that have shown promise for nonincorporated, preemergence control of itchgrass are MON 13211, C-4243, clomazone, and fomesafen. **(R.W. Millhollon)**

<u>Sugarcane Tolerance to Herbicides</u>. The new cultivars LCP 82-89, LHo 83-153, HoCP 85-845, and LCP 85-384, were compared with CP 72-370 (herbicide-sensitive control) and CP 74-383 (herbicide-tolerant control) for tolerance to terbacil and asulam. Terbacil was applied at somewhat higher rates than ordinary, and asulam was applied somewhat later than ordinary in order to evaluate the relative herbicide tolerance of the cultivars. The experiments were affected by flooding and/or unusual weather, but some general conclusions can be made. All of the cultivars had some yield loss from both terbacil and asulam, but none of the new cultivars were overly sensitive to these herbicides. LHo 83-153 was more tolerant to terbacil than was either CP 72-370 or CP 70-321 and appeared to be about equally as tolerant to terbacil as CP 74-383. **(R.W. Millhollon)**

<u>Biological Control of Johnsongrass</u>. Loose kernel smut disease of johnsongrass has shown promise as a biocontrol agent. An infection rate of 100% has been obtained when plants are inoculated hypodermically with the naturally occurring teliospores, but water sprays of teliospores have produced an unacceptably low rate of infection. Recent research has concentrated on using laboratory-cultured sporidia for infection. In one experiment, johnsongrass plants sprayed with sporidia in an oil-in-water invert solution had an infection rate of 0, 10, and 47% when applied once, twice, or three times, respectively. This rate of infection is lower than needed for effective control and research is continuing. **(R.W. Millhollon)**

<u>Johnsongrass and Bermudagrass Control in Sugarcane</u>. <u>Preemergence Herbicides</u>. When applied in early spring postemergence to the crop and preemergence to seedling johnsongrass, imazapyr at 0.13 lb/A, AC 263,222 at 0.2 lb/A, clomazone at 2.0 lb/A, fomesafen at 0.5 lb/A, and a tank mixture of prodiamine and atrazine at 1.5 plus 1.8 lb/A provided excellent control of seedling johnsongrass. Cane and sugar yields following these treatments were equivalent to those obtained where johnsongrass was controlled with standard applications of metribuzin, terbacil, and a mixture of pendimethalin and atrazine. In addition, clomazone at 2.0 lb/A suppressed bermudagrass development in first-ratoon sugarcane to levels equivalent to those observed in plots treated with metribuzin or terbacil at standard rates. Application of metribuzin or terbacil each spring of a 3-yr

sugarcane cycle slowed the development of bermudagrass. As a result, yields of cane and sugar in plots infested with bermudagrass and treated with either metribuzin or terbacil were equivalent to plots maintained free of bermudagrass throughout the 3-yr crop cycle. **(E.P. Richard, Jr.)**

Postemergence Herbicides. Postemergence control of rhizomatous johnsongrass in second-ratoon sugarcane crops with nicosulfuron and primisulfuron was compared to a standard postemergence application of asulam. Asulam applied at 3.3 lb/A in April provided 78% control of johnsongrass and increased sugar yields by an average of 117% over an untreated check. Johnsongrass control with nicosulfuron was higher than with primisulfuron. Late-season johnsongrass control, based on panicle numbers, indicated that nicosulfuron at 0.4 oz/A was as effective as asulam at 3.3 lb/A. Despite some early-season crop injury following treatment with nicosulfuron, yields of sugar were equivalent to those obtained with asulam. Both nicosulfuron and primisulfuron were ineffective in controlling bermudagrass within the sugarcane crop. **(E.P. Richard, Jr.)**

Johnsongrass Control with Asulam. Johnsongrass control in second-ratoon sugarcane was not improved by tank mixtures of asulam with the residual herbicides atrazine, metribuzin, pendimethalin, and terbacil compared to asulam applied alone. Johnsongrass injury symptoms appeared sooner when asulam was applied in mixtures with either DSMA or MSMA, but johnsongrass control 4 weeks after treatment was similar to asulam applied alone. Increases in cane and sugar yield over those obtained with asulam applied alone were not obtained by any of the mixtures because johnsongrass control was not improved. Asulam applied again in May to johnsongrass regrowth improved late-season control in two of three studies over a single early April application, but cane and sugar yields were not increased as a result of the added johnsongrass control. The effect of water volumes of 5 to 60 GPA on the performance of asulam was investigated in six field studies. Late-season johnsongrass control, based on panicle counts, was highest when May applications of asulam were made at broadcast volumes of 10 to 30 GPA. **(E.P. Richard, Jr.)**

Control of Bermudagrass in Fallowed Fields with Glyphosate. The use of glyphosate in fallowed fields to control bermudagrass once sugarcane rows had been reformed was compared to the conventional opening and closing of the rows at 3-4 week intervals. Where rows were opened and closed three times (June 30, July 25, and August 29), bermudagrass covered 48% of the replanted rows in December. Where an application of glyphosate at 2 or 3 lbs/A replaced the third plowing, December bermudagrass infestations averaged 19%. Where the June through August plowings were replaced by two 3.0 lb/A applications of glyphosate, December bermudagrass infestations averaged 14%. Theoretical sugar yields in the subsequent plant-cane crop averaged 6100, 7300, and 7700 lbs/A in the plowed three times, plowed twice plus glyphosate, and the two applications of glyphosate plots, respectively. The postemergence herbicides fluazifop-P, quizalofop, and glufosinate were evaluated as alternatives to glyphosate for the control of bermudagrass in fallowed sugarcane fields. Bermudagrass infestations after the replanting of sugarcane in fallowed plots treated with these herbicides was equivalent to that observed in fallowed plots treated with glyphosate at 2.0 and 3.0 lb/A. Weed control with fluazifop-P and quizalofop was limited to grasses, however. As a result, theoretical sugar yields in the subsequent plant-cane crop was highest where fallowed plots were treated with glyphosate. **(E.P. Richard, Jr.)**

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[a] Common name and trade name of herbicides mentioned in this report: AC 263,222 = CADRE; asulam = ASULOX; atrazine = AATREX; C-4243 = experimental (Uniroyal Chemical Co.); clomazone = COMMAND; DSMA = several trade names; fluazifop-P = FUSILADE 2000; fomesafen = REFLEX; glufosinate = IGNITE; glyphosate = ROUNDUP; imazapyr = ARSENAL; metribuzin = SENCOR/LEXONE; MON 13211 = experimental (Monsanto Agricultural Co.); MSMA = several trade names; nicosulfuron = ACCENT; pendimethalin = PROWL; prodiamine = BARRICADE; primisulfuron = BEACON; quizalofop = ASSURE; terbacil = SINBAR; trifluralin = TREFLAN.

GROWTH REGULATORS

Chemical Ripeners. In a 3-yr ripener study, the sodium sesque salt of glyphosate (POLADO) was applied annually at 0.3 lb/A to plant-cane and the subsequent ratoon crops of cultivars CP 65-357, CP 70-321, and CP 74-383. Cane was harvested by machine at 28- and 42-day treatment-harvest intervals and weighed. Juice was extracted from samples by either the press or roller-mill methods, analyzed, and theoretical recoverable sugar (TRS) determined using appropriate procedures for each method of extraction. Sugar/A was calculated using the yield of cane and TRS. Glyphosate consistently increased TRS in all three crops and at both treatment-harvest intervals, as an average of all cultivars, but the magnitude of the increases was less when TRS was calculated using the press method as compared to the roller-mill method. When the press method was used, glyphosate at the 42-day treatment-harvest interval increased sugar/A over the untreated controls by 7.2%, 0.0%, and 5.8% in the plant-cane, first-ratoon, and second-ratoon crops, respectively. The lack of an increase in sugar/A in the first-ratoon was caused by a combination of glyphosate treatment in plant-cane and a severe freeze that occurred after plant-cane was harvested. These two stresses caused a reduction in cane stands and yield in the first-ratoon, particularly for CP 65-357. Sugarcane stands recovered and were not significantly different from the controls in the second-ratoon crop. The glyphosate treatments increased total yield of sugar/A for the 3-yr period by 3.9%, as an average of all cultivars. **(R.W. Millhollon and B.L. Legendre)**

1991 Climatic Conditions

Sugarcane Field Laboratory, Houma, Louisiana

	Temperature, °F		Rainfall, in.		No. rainy days	
Month	Mean	Depart.	Total	Depart.	Total	Depart.
Jan.	52.4	- 2.5	13.92	+ 9.64	14	+ 6
Feb.	57.1	+ 0.2	5.71	+ 1.42	6	- 2
Mar.	63.3	+ 0.8	5.00	+ 0.57	8	0
Apr.	70.2	- 1.6	11.46	+ 7.24	13	+ 7
May	76.1	+ 1.4	20.84	+16.34	14	+ 7
June	79.7	- 0.2	4.95	+ 1.12	12	+ 2
July	81.5	+ 0.3	11.89	+ 3.80	16	+ 1
Aug.	80.3	- 2.1	9.17	+ 1.92	17	+ 3
Sept.	76.8	- 1.6	8.28	+ 1.58	11	+ 1
Oct.	70.4	+ 0.6	6.65	+ 2.90	6	+ 1
Nov.	55.0	- 6.1	1.59	- 2.24	6	0
Dec.	58.0	+ 3.0	2.34	- 2.58	7	+ 1
Total	820.8	- 4.6	101.80	+39.47	130	+25

1992 Climatic Conditions

Sugarcane Field Laboratory, Houma, Louisiana

	Temperature, °F		Rainfall, in.		No. rainy days	
Month	Mean	Depart.	Total	Depart.	Total	Depart.
Jan.	50.0	- 4.9	11.96	+ 7.68	13	+ 5
Feb.	58.2	+ 1.3	10.16	+ 5.87	8	0
Mar.	61.3	- 1.2	5.08	+ 0.65	9	+ 1
Apr.	66.0	- 2.6	2.22	- 2.00	9	+ 3
May	72.3	- 2.4	2.97	- 1.53	6	- 1
June	79.4	- 0.5	6.75	+ 0.68	12	+ 2
July	81.3	+ 0.1	8.63	+ 0.54	15	0
Aug.	78.6	- 3.8	12.63	+ 5.38	14	0
Sept.	77.1	- 1.3	5.90	- 0.80	14	+ 4
Oct.	68.4	- 1.4	0.68	- 3.07	3	- 2
Nov.	57.1	- 4.0	11.72	+ 7.89	8	+ 2
Dec.	57.7	+ 2.7	5.52	+ 0.60	13	+ 5
Total	807.4	-18.0	84.22	+21.89	124	+19

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